

# Modeling Ecological Functions for Ecosystem Service Management of Great Salt Lake Wetlands

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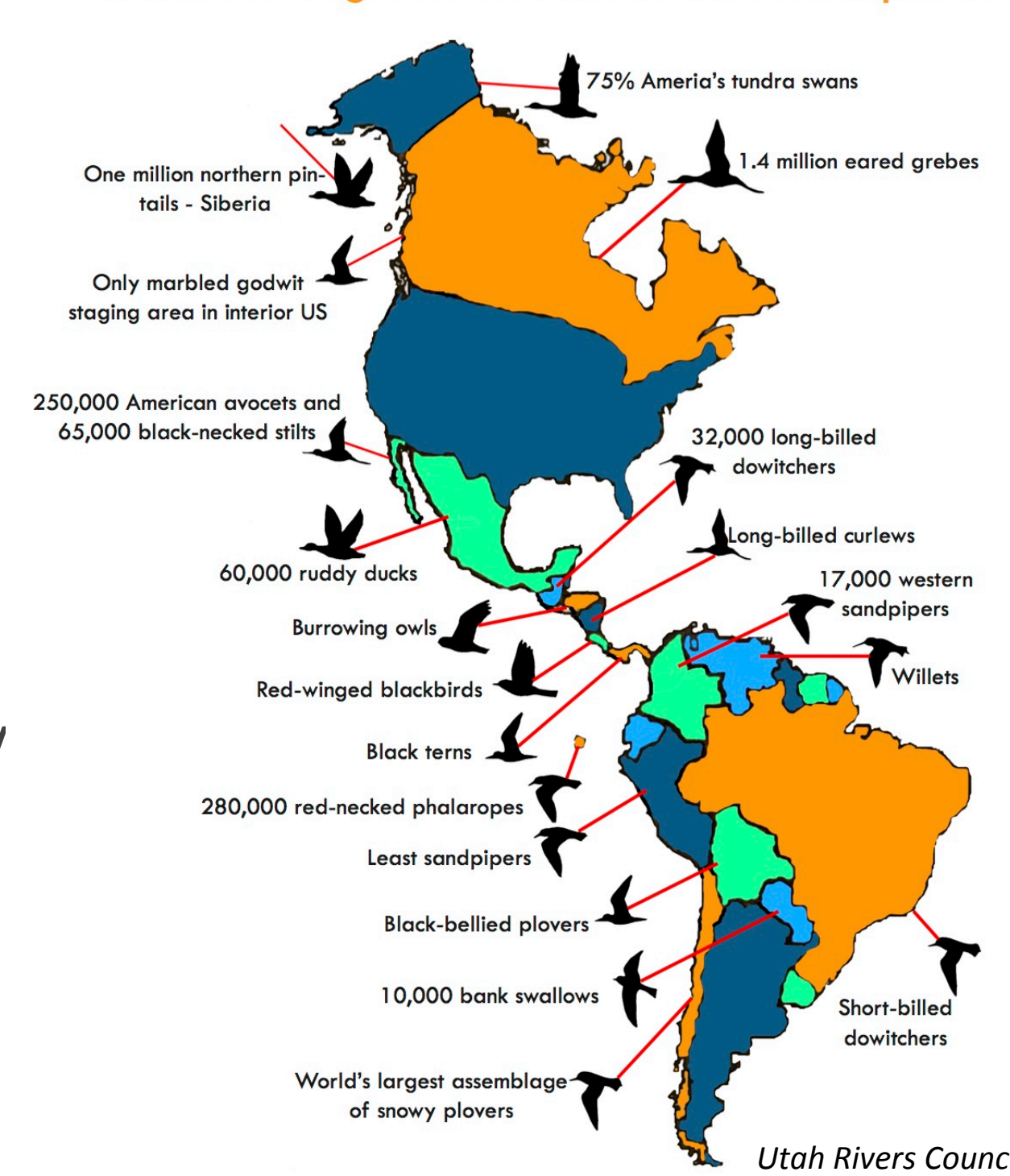
## Great Salt Lake Wetlands Background

Ecosystem services (ESS) are the benefits people receive from the environment<sup>1</sup>. Many ESS are difficult to assess, and so proxies (such as ecological functions) are typically measured in the field<sup>2</sup>. While most ecological functions and processes do not provide a direct service to people, they are the bedrock upon which ESS provisioning relies.

## Significance

GSL and its wetlands have been nationally and internationally recognized for the critical habitat they provide migratory birds in both the Pacific and Central Flyways<sup>3</sup>. GSL hosts 75% of Utah's wetlands, which are an "at-risk" habitat in the arid Great Basin, and provide many unique ESS, such as water quality improvement. The vast majority of GSL wetlands are highly managed and researched for these reasons.

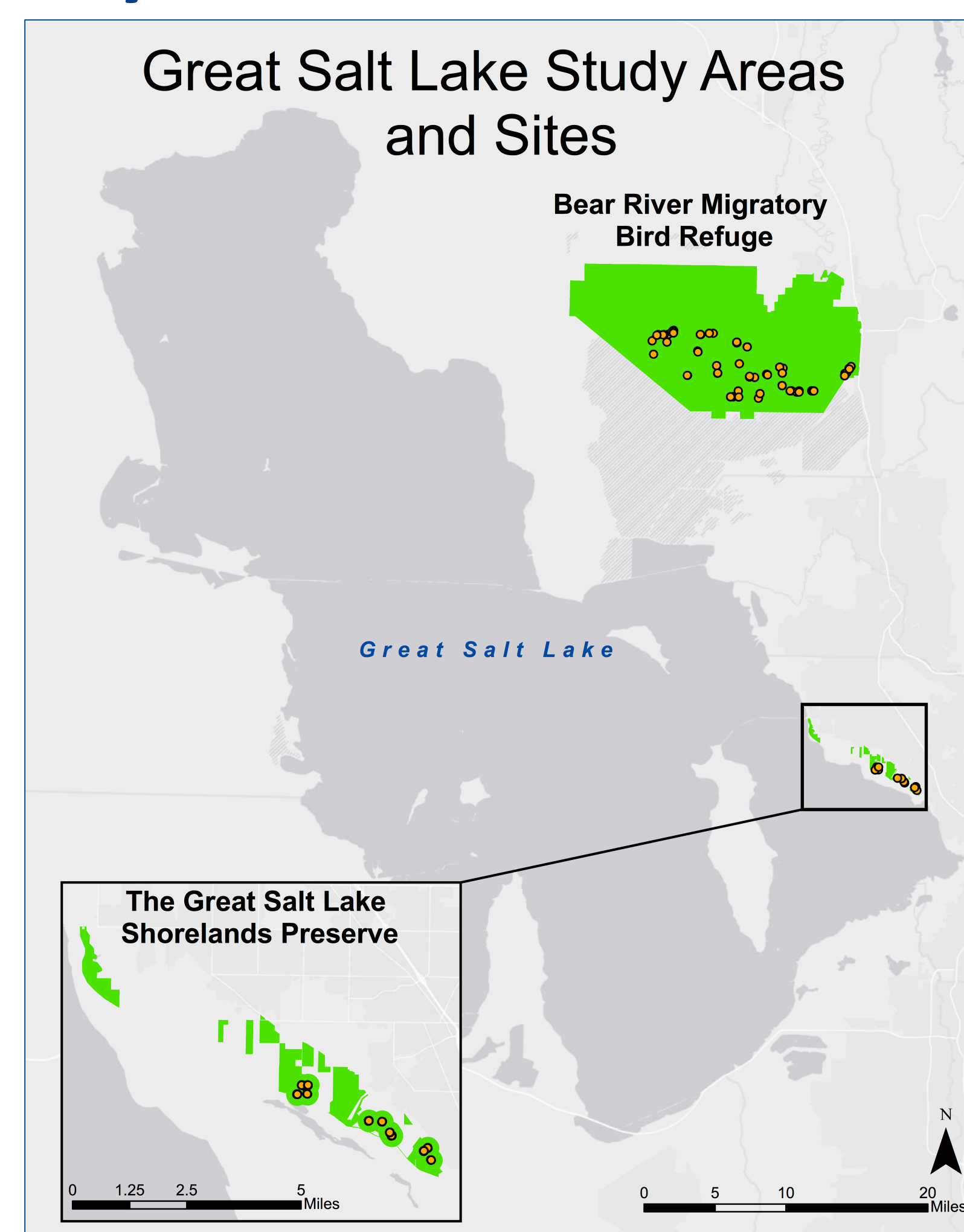
The Great Salt Lake is Critical Habitat for Birds Throughout the Western Hemisphere



## Research Objectives

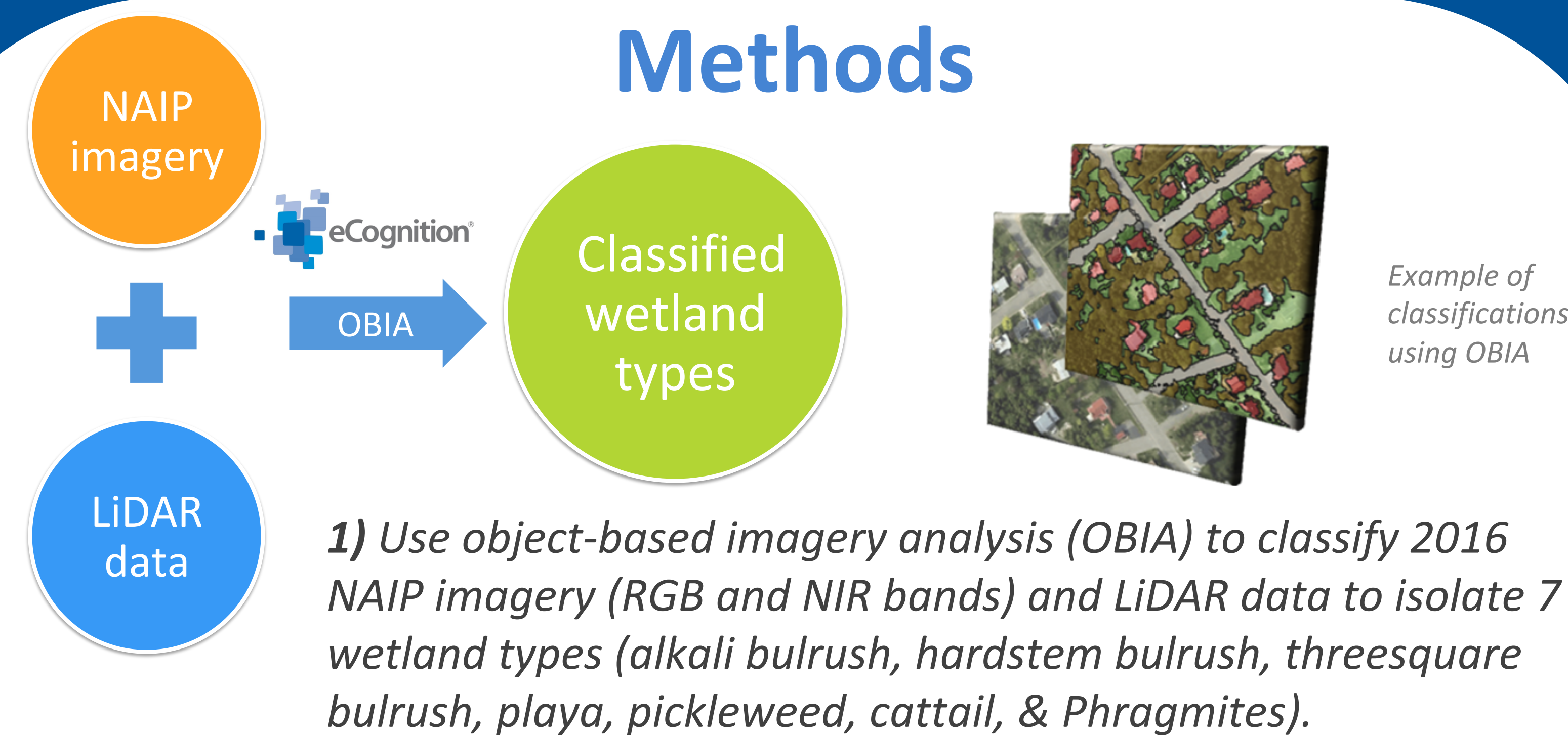
- Map wetland types using object-based imagery analysis
- Model ecological functions performed by GSL wetlands
- Create optimized management plans to improve functions and services while minimizing costs to wetland managers
- Quantify the relationship between costs and functions

## Study Area



- 2 Study sites: BRMBR & GSL Shorelands Preserve
- Managed by USFWS & TNC for all types of migratory birds
- ~34,000 ha altogether
- Impounded & unimpounded wetlands
- Stressed by water quality and quantity issues, & the spread of *Phragmites australis*

## Methods

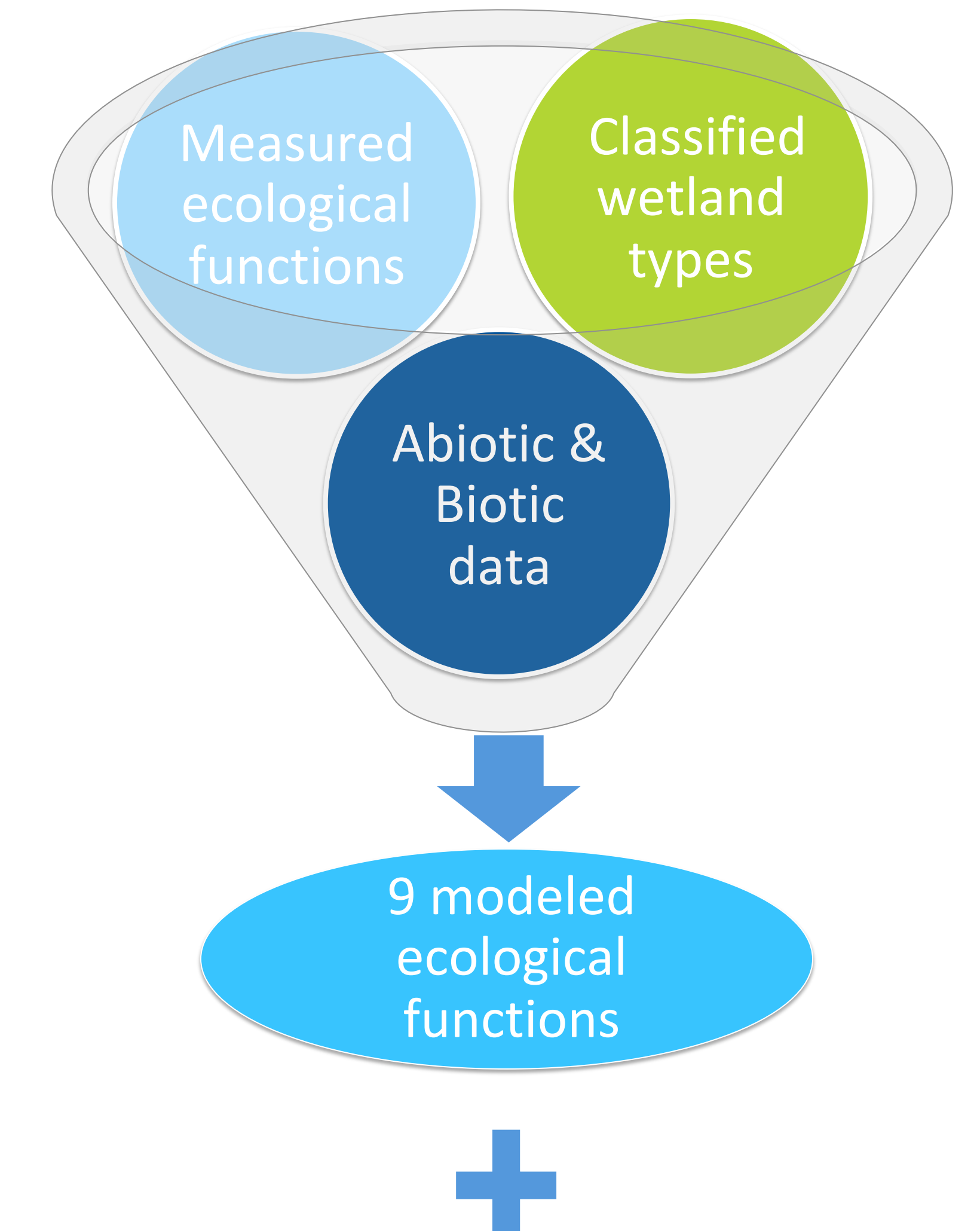


2) Use 7 classified wetland types, 9 ecological functions (measured by Maya Pendleton), and other necessary data (e.g. elevation, slope, proximity to disturbance, etc.) to model ecological functions across the study areas.

Measured Functions:

- Sedimentation rates
- Above-ground and below-ground carbon & nitrogen
- Plant biomass
- Seed production
- Avian abundance & diversity
- Heavy metal uptake

3) The 9 modeled ecological functions, costs for land management, and created planning units are the main inputs to Marxan, a systematic landscape planning software. Marxan takes these inputs, and creates an optimized management area network while minimizing costs to managers and meeting set conservation targets<sup>4</sup>. Marxan will be run multiple times at varying targets for each function, and then with all functions at the same time.



## Expected Results

### Scenario Assessment

There will be ten total scenarios: one for each function (9), and one with all functions together. Marxan will be run 18 times for each scenario at varied targets, starting at 10% and increasing in 5% increments to 95%. Marxan's outputs from these scenarios will allow us to quantify the relationship between target size and cost to management for each scenario. We will then calculate the amount of function attained per each U.S. dollar spent on the landscape. Through target scenario comparisons, we can identify any spatial correlations and tradeoffs between functions, and understand financial implications of management practices.

### Synergies and Tradeoffs

This research will likely uncover tradeoffs and synergies among ecological functions performed by wetland types in these complexes. Tradeoffs occur when one function or ESS happens at the cost of another. For example, *Phragmites* is known to improve water quality through sediment retention and nutrient cycling, but provides little to no habitat for most migratory bird species. Other wetland types are likely to exhibit different tradeoffs or synergies.



### Implications for Management

GSL wetland managers will have:

- a cost-benefit analysis for managing functions (and thereby ESS)
- information about ESS synergies and tradeoffs occurring across the landscape
- an optimized management area network for each individual function and all functions together that minimizes cost and reaches management goals



### References

1. Millennium Ecosystem Assessment, 2005. World Resources Institute
2. Martinez-Harms & Balvanera, 2012. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 8(1-2), 17-25.
3. Vest & Donnelly, 2013. *2013 Implementation Plan*, 3. Intermountain West Joint Venture
4. Joseph et al., 2009. *Conservation Biology*, 23(2), 328-338.



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